ON THE ORIGIN OF THE CHOUTEAU FAUNA.

In a recent number of the JOURNAL OF GEOLOGY appeared an interesting paper discussing the Chouteau fauna of southern Missouri and its relations to the geographical conditions of the region in which it lived and to the other faunas living before it appeared.[1]

Although personally acquainted with the careful work done by the author on this and associated faunas, having gone over much of the ground discussed in this paper with him, still I am not quite prepared to accept the author's interpretation of his facts. And it is because his conclusions seem in some degree to be based upon principles which I have defended in papers already published, that I feel called upon to state in particular my reasons for dissenting from two of the opinions there expressed. The first of these opinions is expressed in Mr. Weller's proposition that the Chouteau fauna of Missouri, although not identical with it, was contemporaneous with the Chemung fauna of New York (p. 916). The second opinion is the conclusion, drawn from a comparative study of the genera and species of the fauna, that it arose from the mingling of two faunas, the one coming from the east, and represented in Devonian time by the Hamilton fauna of New York, and the other, the general Devonian fauna of Europe represented by the middle Devonian fauna of Iowa and British America.

The first of these conclusions seems to be consistent with, and but an extension of views advanced by me regarding the shifting of fauna.[2] But in order to speak of a fauna as moving from place to place and as occurring in one place above or below

[1] A Circum-insular Palæozic Fauna, by STUART WELLER, JOUR. GEOL., Vol. III., pp., 903–917.

[2] Proc. Amer. Assoc. Adv. Sci., Vol. XXXIV., pp. 222–234, 1886, and Amer. Geol., Vol. X., pp. 148–169, 1892.

the horizon it occupies in another, it is necessary to prove the identity of the moving fauna in its different localities; and, second, to have a continuous datum-horizon, either above or below, with which to measure its lower or higher position. Neither of these conditions are present in the case of the Chouteau fauna.

Furthermore, if the Chouteau fauna of Missouri were equivalent to the Chemung, its species must have descended from ancestors living before the Chemung period; but if it followed the Chemung, it must have been descended from a fauna living in Chemung time. The presence in the Chouteau of such species as *Productus hallana* (=*dissimilis*) and *Rhynchonella* (*Pugnax*) *acuminata* does not signify identity of age with the base of the New York Chemung, for two reasons. First, they belong to a part of the fauna which was directly continued up into the Carboniferous. It was this peculiarity which led to designating the fauna containing them as having a "Carboniferous aspect." The Hamilton fauna of New York lacked this Carboniferous aspect, while the middle Devonian faunas of Iowa and of Europe possess it, and it was this fact which suggested the interpretation of the Cuboides zone as evidence of the incursion of the new fauna from the west into the New York area.[1]

The second reason is that the presence of these species in the Chouteau does not indicate that the fauna is Devonian in the face of its many species of distinctly Carboniferous age, any more than their presence in the High Point fauna pointed to its Carboniferous age because *Rhynchonella acuminata* was a typical Carboniferous form. The fact that they are both contained in the typical Devonian beds of Iowa explains their presence both in the New York and Missouri rocks, but does not indicate identical age. The statement about "appearing as they do for the first time after the removal of the land barrier" furnishing good ground for this correlation, ceases to be forcible when we put the question, how do we know anything about the time the barrier was removed, except through the testimony of

[1] Bull. Geol. Soc. Amer., Vol. I., pp. 481–500, 1890; Amer. Jour. Sci. (3), Vol. XXV., pp., 97–104, 1883.

the fossils? Since the faunas are not the same it is necessary to assume some kind of barrier to separate them if they were contemporaneous.

But there seem to be very good reasons for continuing to believe that the two faunas are not contemporaneous, three of which are as follows:

1. The general facies of the fauna (generic as well as specific) is that of the typical Carboniferous faunas of both America and Europe, while the Chemung fauna is typically Devonian.

2. Several of the genera and species of the Chouteau fauna are not known in any Devonian rocks of America or Europe, but are present in other Carboniferous rocks of both America and Europe.

3. The other faunas which present closest relationship to that of the Chouteau are the Kinderhook, Marshall and Waverly, and wherever these faunas are known to succeed fossil-bearing rocks in continuous sections, they are above the Chemung faunas.

Until some evidence is at hand to show that one or other of these propositions does not represent the facts, it would seem to be necessary to regard the Chouteau as of more recent age than the Chemung of New York.

The second point, the dual origin of the Chouteau, seems to be a legitimate extension of the general principle assumed by me in explaining the cuboides[1] and succeeding faunas in New York state. It was with the expectation of finding this to be the fact that I gave the paper the same searching scrutiny which I found it necessary to give my own notes on the Cuboides fauna before I published them. As Mr. Weller states that he believes "the key to the whole problem (of the origin and evolution of the Mississippian fauna) is to be found in the dual origin of the faunas" as set forth in his paper (p. 915), the importance of making sure that there was a dual origin is apparent.

If, however, we have no evidence of any further duality of origin than that supposed to account for the Cuboides fauna in

[1] The Cuboides Zone and its Fauna, Bull. Geol. Soc. Amer., Vol. I., pp. 481–500.

the New York Chemung, it will promote the main investigation, in which I am as thoroughly interested as Mr. Weller can be, to have the fact clearly expressed at the outset.

The belief in the dual origin of the Chouteau fauna is drawn by Mr. Weller from an analysis of the fauna itself. I have examined the lists and the argument for new evidence bearing upon the general problem of the movement and modification of the fossil faunas concerned, but the evidence appears to me conclusive in proving a single and direct origin from the one general European type of Devonian represented already in the Devonian faunas of Iowa and other regions of the north and west.

Critical examination of the genera listed as belonging to the "East-American Devonian Province," but wanting in the "West-American and European Devonian Province" does not confirm the opinion of an origin for any of the genera directly from the former eastern province.

The genera so listed are *Aviculopecten*, *Cardiopsis*, *Edmondia*, *Pterinea*, *Sphenotus*, *Straparollus*, *Gennæocrinus*, *Platycrinus*, *Scaphiocrinus*, *Michelinia*.

Regarding them the following comments may be made:

Aviculopecten is reported in numerous species as European Devonian by Frech [1] and Tscherneyschew.[2]

Cardiopsis is a form of such uncertain generic affinities that the absence of the genus should not be concluded from the absence of the name in lists of foreign faunas. The close relationship of the one species, recognized by this generic name from America by Hall, to *Cardiomorpha*, *Megambonia*, *Dexiobia* and *Dualina* is sufficient to prevent it from furnishing any positive evidence of origin outside of the typical European Devonian.

[1] FRECH, Die Devonischen Aviculiden Deutschland, K. Preuss, Geol. Lands, Abhandl.

[2] TSCHERNEYSCHEW, Special Karte v Preuss, a Thüring, Staaten, Bd. IX. bft. 3, 1891.

Die Fauna des unteren Devon am Ostabhunge des Ural. Mem. du Comité Geol., Vol. IV., No. 3, 1893.

Edmondia De Koninck is a form of doubtful affinities and was described from Carboniferous specimens. Although it occurs in New York it is there a Chemung form, and on the theory that the Chouteau is later than the Chemung, there is no difficulty in supposing a common origin for its species. For if we apply the theory that these species came from the eastern Hamilton, we have the same reason for so accounting for the origin of the *Edmondias* of European Carboniferous, which is evidently absurd.

Pterinea Goldf. is a genus of wide range, from the Silurian to the Carboniferous, and its absence from a particular list of species in Devonian time cannot be taken as evidence that it was not then living under appropriate conditions in the same seas.

Sphenotus, until distinguished by Hall, in 1895, was recorded under the name *Sanguinolites* McCoy, or *Cypricardia* Lam., or *Cypricardinia* Hall. The genus under these names was known in the European Devonian, and one does not need to look to the eastern New York Devonian for its origin in the Chouteau.

Straparollus Montf. is reported under that name in Europe from the Silurian to the Triassic, and it is an ancient type and should not as a genus be used as indication of local origin of any fauna so late as the Carboniferous era.

All the other genera of Lamellibranchiata and Gastropoda, as well as all the Brachiopoda named in the list were known in the western or European Devonian fauna.

The crinoids mentioned, if not included in lists of European Devonian species may be there omitted because they did not appear until the Carboniferous time, in which case we have to account for their presence there as well as in America, or, as in the case of *Platycrinus* and *Scaphiocrinus*, they are only rarely found below the Carboniferous, and have to be accounted for as newly evolved genera rather than as descendants of species of the same genus in lower rocks.

The case of *Michelinia* must have been an oversight, for the genus is reported under that name from the Devonian of Europe,

and under the name *Pleurodictyum problematicum* Goldf. is a characteristic Devonian form of Europe as well as America.

Since all other genera in the list are known to have been present in the western Devonian fauna, there appears no positive evidence of a generic character to point to any double origin of the fauna.

Mr. Weller also cites a number of species as evidence of origin from two sources. Those traced to species in the western Devonian fauna require no comment; those for which an eastern origin is suggested are the following: *Athyris hannibalensis* Swallow, (*A. spiriferoides*); *Leptæna rhomboidalis*; *Orthis Michelini* (*O. vanuxemi*): *Eccyliomphalus paradoxus* (*E. laxus*); *Loxonema cf. hamiltonæ*.

Regarding the origin of these species, it may be said in general that the presence of closely allied forms in one Devonian fauna and nothing at all like them in a second great province, might be regarded as pointing to an origin from the first rather than the second source, but if there are species with equally close affinity in both provinces, then some other evidence must appear before we can say from which the later fauna has arisen.

Athyris hannibalensis may have found its ancestors among the common and very variable *A. concentrica* von Buch, of the European Devonian, as well as from the more specialized *A. spiriferoides* of the New York Hamilton.

Leptæna rhomboidalis is such a widespread, old and variable form that it would not be safe to say that it was wanting in any complete Devonian fauna.

Orthis michelini may have arisen from the *O. vanuxemi* of the Iowa Hamilton as well as from the same species in the eastern fauna.

Any species of genera of such wide range and variable character as either *Eccyliomphalus* or *Loxonema* cannot be safely cited as evidence without particular study and the discovery of some special distinguishing mark.

Eccyliomphalus Portlock is cited as a synonym under *Phanerotinus* Sow. by Zittel as having a range from Silurian to the Car

boniferous[1] and Hall[2] includes that genus as a synonym under *Euomphalus*, which is abundantly represented in the European Devonian fauna.

The genus *Loxonema* is as old as the Ordovician and the species are all so much alike in their general habit and variations that in order to trace the origin of any particular Carboniferous species, it would be necessary to show that it possessed some distinctive mark found in the species of some particular Devonian province and absent from the representatives of the genus of all other Devonian faunas. Thus we are led, by a critical review of both the genera and species, of which an origin from outside the Mississippi province of Devonian time is suspected, to the conviction that there is no positive evidence of such a course. On the other hand there seems to be no reason to doubt the natural succession of the Chouteau fauna from the Devonian fauna already in the province.

Although there seems to be little or no evidence that the Chouteau fauna was not all derived from one common source, it is not impossible that there may be traces of species which were not descended from any Devonian species of Europe. If the evidence brought forward in the paper on the Cuboides zone will bear the interpretation put upon it, there was such a mingling of two quite distinct faunas at the opening of the Chemung period in the New York area. There are no facts known to me to prevent the supposition that the Chouteau fauna may have species derived from the older fauna, but Mr. Weller does not mention any such facts, and I am not aware that there are any.

If it could be shown that the Chouteau fauna was of the same age as the base of the Chemung, it might be inferred that the mingling of faunas from different sources, which is supposed to have taken place in the New York region, affected also the faunas in the Ozark region of Missouri; but if the Chouteau is later than the Chemung, as I believe was the case, then the

[1] Handbuch der Palæontologie, II., p. 207.

[2] Palæontology, New York, Vol. V., Part II., Text, p. 54.

mixed fauna already occupied the eastern area when the Chouteau began, and from the evidence of the distribution of the Marshall and Waverly faunas, it is probable that it occupied the whole of the marine waters then lying over the interior of North America.

In conclusion I wish to emphasize a particularly valuable point made in the paper, viz., the connection between a new fauna and the sinking of the land. The theory of my Cuboides zone paper required some such hypothesis as this to account for the sudden incursion of the general western and northwestern Devonian fauna over the New York area. Mr. Weller has suggested a reasonable solution of the problem. But there is a still further inference to be drawn from this and similar facts. May not the occupation by the ocean of recently depressed land and the changed conditions of environment thus brought about, be a fertile and general cause in the modification of the faunas? From the facts already known, the inference seems quite probable that the initiation of new faunas, containing new genera, as well as new species, which is observed on tracing the succession of formations upwards in time, is intimately associated with the occupation by the seas and their contained organisms of recently depressed land surfaces.[1] Such radical modification of the conditions of environments as would thus take place furnishes a reasonable condition for the special activity in evolutional processes, which is indicated by the sharply distinct character of the faunas immediately following an unconformity such as is often noticed. The selective effects of migration from the midst of a general and adjusted fauna into new conditions of environment will undoubtedly account for some of the faunal changes which were taking place throughout geological time; but nowhere in a series of continuously forming strata is found such definiteness of grouping of the species of a fauna as after an unconformity, indicating depression of the land after a period of elevation and erosion.

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[1] See Ortmann's discussion of isolation as a factor in evolution. *Grundzüge der marinen Tiergeographie*, June 1896.